ORIGINAL RESEARCH

Pregnancy After Classic Cesarean Delivery

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OBJECTIVE: To describe maternal and perinatal outcomes after a prior classic cesarean delivery.

METHODS: A retrospective review was performed including all patients from 1990–2000 whose most recent pregnancy was preceded by classic cesarean delivery.

RESULTS: During the 11-year period, there were 37,863 deliveries and 157 patients (0.4%) underwent classic cesarean operations. In the next pregnancy, one case of uterine rupture (0.6%, 95% confidence interval 0.1, 3.5) occurred at 29 weeks without preterm labor and resulted in fetal death. The prevalence of asymptomatic dehiscence was 9% (95% confidence interval 5, 15). There was no significant difference between patients with uterine dehiscence ($n = 15$) and patients with intact uteri ($n = 141$) with regard to maternal demographics, duration of labor, cervical dilatation at time of surgery, transfusion of packed red cells, bowel injury, postpartum endometritis, wound breakdown, thrombophlebitis, or umbilical arterial pH less than 7.00 ($P > .05$). Duration of labor, cervical dilatation, and gestational age at repeat cesarean delivery were poor predictors for uterine rupture or dehiscence.

CONCLUSION: Among patients with prior classic cesarean delivery, uterine rupture and dehiscence are neither predictable nor preventable. One in four patients will experience some form of maternal morbidity. Uterine rupture, although infrequent, can be fatal to the fetus. Uterine dehiscence, however, does not increase neonatal or peripartum maternal morbidity. (Obstet Gynecol 2002;100: 946–50. © 2002 by The American College of Obstetricians and Gynecologists.)

Classic cesarean delivery is used infrequently because of the potential for subsequent uterine rupture,[1] difficulty with uterine repair, prolonged operative time, and increased blood loss.[2] Despite detractions, classic cesarean delivery may be necessary in a variety of clinical circumstances. These scenarios include, but are not limited to, a preterm fetus with malpresentation, inability to access the lower uterine segment because of adhesions or massive maternal obesity, a narrow, unlabored lower uterine segment, or a very stressed or distressed preterm fetus with need for immediate delivery.[3–5] Perhaps because of the infrequent use of this type of uterine incision in modern obstetrics, there is a paucity of publications reporting a large patient series with pregnancy outcomes after prior classic cesarean surgery. Thus, we were prompted to review our experience with all classic cesarean deliveries that were managed at a single tertiary center.

The two purposes of this retrospective review were to: 1) describe the maternal and perinatal outcomes of subsequent pregnancies in patients with a prior classic cesarean delivery, and 2) compare the pregnancy profiles of patients who did or did not develop later uterine rupture or uterine dehiscence.

MATERIALS AND METHODS

After Institutional Review Board approval, a search was undertaken to identify all patients at the University of Mississippi Medical Center with prior classic cesarean surgery and subsequent delivery during the 11 years inclusive of 1990–2000. The departmental computer database as well as the delivery unit logbooks were used to identify study subjects. The medical record for each patient was reviewed to ascertain demographic data, the reason(s) for undertaking the original classic cesarean operation, and details of the intrapartum and postpartum courses. Any patient with a prior low-segment vertical incision was excluded from the analysis. If a patient with a prior classic cesarean delivery had more than one subsequent pregnancy, only the next pregnancy was used for analysis.

Early during prenatal care, our practice is to review the operative report if a patient has had a prior cesarean delivery. If the patient has a documented prior classic cesarean incision, amniocentesis for the assessment of fetal lung maturity is scheduled at approximately 36 weeks' gestation before planned repeat cesarean delivery. If delivery earlier than 36 weeks is mandated by medical or obstetric reasons, repeat cesarean is accomplished without prior amniocentesis. At surgery, the

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diagnosis of uterine dehiscence is made if uterine scar separation is present without penetration of the uterine serosa, the fetus is clearly visible within the uterus beneath only a layer of membrane when the maternal abdomen is opened, there is no bleeding from the uterine scar edges, and emergent cesarean surgery is not required for maternal or fetal reasons. A diagnosis of uterine rupture is made if the entire thickness of the uterine wall is disrupted and if any of the following conditions are also present: cesarean for suspected fetal distress, fetal parts or placenta/umbilical cord are extruded through the uterine defect, laparotomy to control hemorrhage from the defect, the disrupted uterus is bleeding, and/or hysterectomy or repair of the uterus or bladder is needed. In each case, the size of the uterine defect was approximated and noted in the operative report. Umbilical artery blood gases were assessed for each patient at surgery.

The Student t test or Wilcoxon rank-sum test (nonparametric), as determined by the Kolmogorov-Smirnov statistic, were used to compare continuous data. For proportional data, χ^2 and Fisher tests were used where appropriate; odds ratio and confidence intervals (CI) were calculated. Receiver operating characteristic curves were constructed, and areas were calculated to determine if duration of labor, gestational age, or the maximum cervical dilatation could be used to predict uterine dehiscence. $P < .05$ was considered significant.

RESULTS

Among the 37,863 patients with live-born deliveries during 11 years at our tertiary center, 157 (0.4%) underwent classic cesarean delivery. Indications for surgery are listed in the upper portion of Table 1. The mean (± standard deviation) time interval between the prior classic and subsequent repeat cesarean delivery was 35.6 ± 23.7 months. Although 83% (131 of 157) of the patients were black, 13% (21 of 157) were white, and the remainder (five of 157) were either Asians or Choctaw American Indians. At the time of repeat cesarean delivery, the mean maternal age was 25.9 ± 5.3 years, and the mean gestational age was 34.8 ± 4.0 weeks.

Only 33% (52 of 157) of the patients in this series underwent amniocentesis to document pulmonary maturity at a mean gestational age of 35.9 ± 1.2 weeks. Almost half of the patients (49%, 77 of 157) presented in preterm labor before amniocentesis or planned repeat cesarean delivery could be accomplished. The mean duration of labor was 7.3 ± 5.6 hours, and the mean cervical dilatation at the time of repeat abdominal surgery was 1.5 ± 2.4 cm. The cervix was dilated 4 cm or more in 17% of the patients (27 of 157). Obstetric factor(s) prompting repeat cesarean delivery are provided in the lower portion of Table 1. The mean operative time for repeat cesarean delivery was 53.8 ± 21.4 minutes, with an estimated blood loss of 919 ± 322 mL. The mean birth weight was 2414 ± 849 g; only three newborns (2%) exhibited neonatal acidosis (umbilical arterial pH less than 7.00). Complications secondary to repeat cesarean delivery included transfusion of packed red blood cells in 5% (eight of 157), and injury to the bowel in 2% (three of 157) of patients during entry into the peritoneal cavity. In each case, the injured area was recognized and repaired intraoperatively. Postpartum endometritis was observed in 14% (22 of 157), and wound breakdown occurred in 8% (12 of 157). Overall, 25% (39 of 157) of the patients had at least one postpartum morbidity.

The only uterine rupture (0.6%, 95% CI 0.1, 3.5) in this series occurred in a patient who presented at 29 weeks with vaginal bleeding. Emergent surgery was undertaken when fetal bradycardia was noted, which remained unresponsive to change in maternal position, hydration, and the administration of oxygen. Although surgery was commenced with crash induction of general anesthesia within 14 minutes of onset of fetal bradycardia, the 1800-g fetus and the abrupted placenta had extruded into the maternal abdomen through a 6-cm

Table 1. Indication for Initial Classic Cesarean Operation (Index Pregnancy) and Subsequent Pregnancy Repeat Cesarean Delivery

Reason for initial classic cesarean delivery	
Fetal distress and difficulty exposing lower uterine segment	36 (23)
Preterm labor and malpresentation	33 (21)
Preterm labor	29 (18.5)
Upward extension of low-segment vertical incision	29 (18.5)
Malpresentation	7 (4.5)
Preterm labor and extension of vertical incision	7 (4.5)
Malpresentation and extension of vertical incision	4 (2.5)
Preterm labor and fetal distress	3 (2)
Others, including inaccessible lower uterine segment	9 (6)
Reason for repeat cesarean delivery with index pregnancy*	
Labor (before planned amniocentesis/ cesarean delivery)	77 (49)
Repeat	64 (41)
Severe preeclampsia	14 (9)
Preterm premature rupture of membranes	10 (6)
Nonreassuring fetal status	2 (1)

Data as *n* (%).
* Some patients had more than one indication for delivery.

Table 2. Subsequent Pregnancy Outcomes Among Patients With Prior Classic Cesarean Delivery

	Dehiscence (n = 15)	Intact (n = 141)	P OR (95% CI)
Age (y)	25.1 ± 5.8	25.9 ± 5.2	.280
Race (black/white/Asian/Native American Choctaw)	12/2/1	117/19/5	.865
Chronic hypertension	1 (7)	16 (11)	0.56 (0.07, 4.53)
Diabetes mellitus	2 (13)	11 (9)	1.82 (0.36, 9.11)
Months between classic and repeat cesarean delivery	29.6 ± 13.5	36.4 ± 24.5	.546
Amniocentesis for pulmonary maturity	4 (27)	48 (34)	0.70 (0.21, 2.33)
Labor	8 (53)	68 (48)	1.23 (0.42, 3.57)
Duration of labor (h)	6.8 ± 1.5	7.3 ± 5.9	.306
Cervical dilatation (cm)	1.8 ± 2.3	1.7 ± 2.4	.684
≥4 cm	2 (13)	24 (17)	0.75 (0.16, 3.54)
Gestational age at repeat cesarean delivery	35.1 ± 3.9	34.7 ± 4.0	.528
<37 wks	9 (60)	100 (71)	0.61 (0.20, 1.84)
Nonreassuring fetal status requiring delivery with index pregnancy	1 (7)	1 (1)	10.00 (0.59, 168.85)
Operative time (min)	62.7 ± 26.8	52.8 ± 20.6	.101
Estimated blood loss (mL)	1020 ± 392	896 ± 284	.299
Birth weight (g)	2613 ± 738	2390 ± 851	.353
Umbilical arterial	7.20 ± 0.08	7.18 ± 0.61	.129
pH < 7.00	1 (7)	2 (1)	4.96 (0.42, 58.29)
Perinatal mortality	0	1 (1)	3.02 (0.12, 77.45)
Transfusion of packed red blood cells	2 (13)	5 (3)	4.18 (0.78, 23.75)
Damage to bowel	0	3 (2)	1.27 (0.06, 25.89)
Endometritis	4 (27)	18 (13)	2.48 (0.71, 8.56)
Wound breakdown	0	12 (8)	0.33 (0.02, 5.93)
Thrombophlebitis	1 (7)	2 (1)	4.96 (0.42, 58.29)
Hospitalization (d)	4.8 ± 1.7	4.2 ± 1.5	.198

OR = odds ratio; CI = confidence interval.
Data as mean ± standard deviation or n (%).

vertical uterine defect. The newborn had 1- and 5-minute Apgar scores of 0 and 0 and could not be resuscitated.

During repeat cesarean surgery for prior classic cesarean, the prevalence of asymptomatic dehiscence was 9% (95% CI, 5, 15). Table 2 is a comparison of the peripartum outcome among the 15 patients with uterine dehiscence versus the 141 parturients who had no disruption of the uterine scar. The two groups of patients did not differ with regard to maternal demographics, prevalence of chronic hypertension or diabetes mellitus, time interval between two consecutive pregnancies, duration of labor, achievement of greater than or equal to 4-cm cervical dilatation, and operative time ($P > .05$). Neither was there a difference between groups with regard to estimated blood loss, need for transfusion of packed red blood cells, or the development of thrombophlebitis ($P > .05$). Neonatal acidosis and perinatal mortality occurred with similar frequency in the two groups.

Receiver operating characteristic curves were constructed to determine if duration of labor, cervical dilatation, or gestational age at delivery could be used to identify parturients at high risk to develop uterine rupture or uterine dehiscence. The areas under both curves (0.35 ± 0.10 for duration of labor, 0.49 ± 0.05 for cervical dilatation, and 0.41 ± 0.11 for gestational age) were not significantly ($P > .05$) different from the area beneath the nondiagnostic line, indicating that none of the three factors are predictors of uterine scar disruption.

DISCUSSION

In contemporary times, classic cesarean delivery is undertaken infrequently and judiciously because it is associated with increased maternal blood loss, an increased potential for uterine rupture with subsequent pregnancies compared with patients with prior low-segment incisions, and it generally mandates subsequent repeat cesarean delivery.[1,2] In certain obstetric circumstances, however, a classic cesarean operation is advisable to perform. Expertise in its performance should be a part of the operative skills of a competent obstetrician-gynecologist.

In the recent obstetric literature, there is a paucity of reports detailing subsequent pregnancy performance and experience among patients with a prior classic cesarean delivery. A PubMed (National Library of Medicine)

search using the search query of "classic cesarean" produced only 53 publications in the English language since 1980. The largest sample size ($n = 70$) of patients with subsequent pregnancy information in recently published papers was by Halperin et al.[4] However, the authors did not differentiate between a prior low-segment vertical delivery and a prior classic cesarean delivery, and they accepted a thinned scar as being abnormal. In contrast, we consider a dehiscence to be present when there remains no muscle or fascia overlying the amnion/chorion at the incision site. The paucity of recently published information about this important issue prompted us to review our personal experience with prior classic cesarean delivery.

There are at least four major findings to note from this investigation. First, although classic cesarean delivery occurs quite infrequently (0.5% of births), the most common setting for its performance is preterm delivery in combination with fetal malpresentation, an undeveloped lower uterine segment, and/or a suddenly nonreassuring fetal condition. Bethune and Permezel[3] also observed a high frequency of preterm delivery (63%, 77 of 123) in the subsequent pregnancies of patients with prior classic cesarean operations.

Second, to possibly reduce the risk of a labor-induced uterine rupture of a prior classic scar, we routinely planned to undertake a diagnostic amniocentesis in these patients at 36 weeks' gestation. This intention could be accomplished, however, in less than half of our patients, and it did not appear to prevent uterine rupture or dehiscence. In our series, 49% of the patients were in labor or had obstetric reasons for delivery before repeat cesarean surgery could be scheduled. Surprisingly, the cervix was dilated 4 cm or more at the time of surgery in 17% of the patients. A possible consequence of these women having a labored uterus being in labor might be a high incidence of scar disruption. In contrast, however, our experience indicates that gestational age, duration of labor contractions, and extent to which the lower uterine segment and cervix is dilated are not significantly different between those patients with or without uterine rupture or dehiscence (Table 2). Nevertheless, we consider it reasonable to plan to undertake diagnostic amniocentesis around 36 weeks' gestation when possible in patients with prior classic cesareans until further research clarifies this issue.

A third finding is that the prevalence of uterine rupture (0.6%, 95% CI 0.1, 3.5) is considerably less than that of uterine dehiscence (9%, 95% CI 5.0, 15). Contained within the Rosen et al[6] meta-analysis of several thousand patients who attempted a trial of labor were 26 women who later were found to have had prior classic cesareans. In this very small population, the frequency of uterine rupture was 12% (three of 26, 95% CI 2.0, 30). Bethune and Permezel[3] reported one uterine rupture among 11 parturients with prior classic cesarean delivery for a 9% incidence of rupture (95% CI 0.2, 41). Although neither of these authors reported a neonatal loss secondary to uterine rupture among the combined series of 37 patients, ours occurred at 29 weeks in a woman who presented with vaginal bleeding absent any evidence of labor. The reason for the disparity between our experience and these two recently published reports could be related to their small sample sizes relative to ours.[3,6] In addition, their higher numbers might be due to combining uterine dehiscence with uterine rupture and only including patients for study if a trial of labor in a subsequent pregnancy were undertaken. The most recent American College of Obstetricians and Gynecologists practice bulletin on vaginal birth after previous cesarean delivery quotes a 4–9% risk of uterine rupture in the subsequent pregnancy of patients with prior classic cesarean surgery.[1] This figure is correct for combined uterine ruptures and dehiscences, but overstates the occurrence of actual uterine rupture in this special patient population.

The wisdom of clinicians practicing in times when classic incision for cesarean was a dominant approach is pertinent to this discussion. Although the incidence of ruptured classic scars was only 1.05% in Douglas' 1969 series[7] of 2910 patients (38.3% or 1115 delivered vaginally by trial of labor), in the fourth edition of the *Douglas-Stromme Operative Obstetrics* textbook (1982), Quilligan and Zuspan emphasized that even a low incidence of uterine rupture after classic cesarean is less important an issue than the extent and significance of subsequent rupture and its timing.[8] Virtually all uterine ruptures in the Douglas series[7] were complete and sudden breakdowns of the incision site with catastrophic effects for the fetus, both rare sequelae for patients in pregnancies preceded by prior low-segment cesarean incisions. Importantly, Quilligan and Zuspan also correctly noted that "the security of the classic scar may be lost at any time beginning with the sixth month,"[8] making it extremely difficult to pick a time early enough in subsequent pregnancy to avoid all risk of a sudden uterine rupture. Our single uterine rupture and fetal loss at 29 weeks' gestation reflect the significance and correctness of both valid concerns for patients with prior classic scars even in the 21st century.

The fourth finding of our analysis is the similar incidence of postpartum complications in patients who had a uterine dehiscence and those with an intact uterus. Both the estimated blood loss and the risk of transfusion of packed red blood cells (odds ratio 4.18, 95% CI 0.78, 23.75) were similar between groups. Moreover, neither

the duration of the hospitalization nor the rate of postoperative complications (endometritis, wound infection, etc) were significantly different between groups (Table 2). This suggests that uterine dehiscence among women with prior classic cesarean delivery usually is a benign condition. This is not a startling finding because uterine scar dehiscence by definition does not involve the entire myometrial thickness and does not require operative intervention.

In any retrospective review there are limitations, one of which is the possibility of bias. To the extent possible, we have attempted to minimize bias by reviewing each of the patients who had a prior classic cesarean delivery and delivered subsequently on our obstetric service. Because some patients could have delivered at other hospitals, our results might be considered approximations. Because we focused only on the first pregnancy subsequent to a classic cesarean delivery, we are unable to provide information about later subsequent pregnancies. It is unlikely that practice patterns changed during the 11-year study interval because almost all patients were managed under the supervision of the senior author. Finally, although we were unable to find a significantly higher risk of neonatal morbidity or morbidity among those with uterine dehiscence versus an intact uterus, this could be due to small sample size. Post hoc sample size calculation indicates that if the risk of neonatal acidosis (umbilical arterial pH less than 7.00) is 1% among patients with an intact uterine wall, then 350 cases of dehiscence would be needed to demonstrate a four-fold increase in low pH (power of 80% and α level of 0.05%). Assuming that 0.5% of patients have a subsequent pregnancy after classic cesarean delivery, and among these patients, the prevalence of dehiscence is 9%, then 883,389 deliveries would be required to attain 350 cases of uterine dehiscence to accrue a sufficiently large sample size to determine if umbilical artery pH is truly influenced by uterine dehiscence.

In conclusion, although the risk of uterine rupture was less than 1% in our series, it can be catastrophic for the fetus and not preventable by using a policy of planned amniocentesis at 36 weeks. Repeat cesarean delivery after prior classic cesarean delivery is attended by notable maternal morbidity (overall 25% risk) including need for transfusion of blood products (3–13%), accidental bowel injury (up to 2%), endomyometritis (13–27%), wound complications (up to 8%), and thrombophlebitis (1–7%). Uterine dehiscence with a prior classic cesarean delivery occurs in approximately 9% of patients, but there is no discernible methodology to facilitate identification of the patient at risk.

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